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The cognitive revolution: a new paradigm for causation *

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A MODIFIED FORM OF CAUSAL DETERMINISM

In the traditional atomistic «microdeterministic» view of science, everything is determined from below upward following the course of evolution. In this view, brain states determine mental states, but not viceversa. In the new view, things are determined reciprocally, not only from lower levels upward, but also from above downward. In the reciprocal, «two-way», or bidirectional model, a molecule, for example, rather than being governed solely by its atomic make-up, becomes also the «master of its inner atoms and electrons». In chemical interactions the space-time course of its atomic components is determined by the overall configurational properties of the molecule as a whole, as well as the other way around (62). This is illustrated, for example, in the often very different chemical properties of mirror image forms of the same molecule. In reference to brain function, «... the simpler electric, atomic, molecular, and cellular forces and laws, though still present and operating, have been superseded by the configurational forces of higher-level mechanisms... these include the powers of perception, cognition, reason, judgement, and the like, the operational, causal effects and forces of which are equally or more potent in brain dynamics than are the outclassed inner chemical forces.» (62, p 20).

In effect, the traditional one-way «bottom-up» view, based in a heretofore supposedly closed, complete scheme for describing the entire natural order including brains, was perceived in the new outlook to be inadequate or flawed, in that its one-way logic omitted the downward control. This shortcoming was perceived to leave an opening in which conscious subjective experience might be included in a causal interactive role (47, 63).

By combining the old "bottom-up" atomistic determinism with an added concept of "top-down emergent determinism", a way was found at long last by which subjective causality might be included within the classic objective account of science. Moreover, the new bidirectional approach made this possible without any loss in the many proven analytic-technologic benefits of science already demonstrated in the conventional one-way approach (excepting, of course, for the former theoretical assumptions that materialist determinism had been a logically airtight and complete system).

In the reformed scheme, the microdeterminist chains of causation already covered in the brain-behavioral and other sciences need not be disrupted, intervened or disposed of. Mostly they are maintained in their existing form and simply surrounded, enveloped, or «supervened» by higher level cerebral systems. The resultant downward causal effects are evidenced, not in a reordering of events within the local details of the brain process, but in the way the lower-level components are ordered relative to things outside the given cerebral process. With respect to a particular given cortical neuron, whether it fires or not, and its firing schedule for the day, is determined by the types of thought, feelings, memories and other higher-level cognitive phenomena that happen to pass through the brain. Unlike proposals that would utilize and amplify any indeterminant quantal influences (16, 32, 70), the type of downward control that is posited actually works in the opposite direction: that is, it tends to protect brain function and its organization against any chaotic, injurious, or other such interference in favour of control through higher-level processes of cognition (66).

The bidirectional, emergent interaction model places emergent properties in a stronger role. Their irreducibility is demonstrated, as is their downward control over lower-level components. Their evolution as novel causal entities is held to introduce into the cosmos (and to science) new control phenomena and forces in their own form and in their own right. Inclusion of both the bottom-up plus the top-down type of inter-level determinism is claimed to be necessary in order to obtain a complete picture of (causal) reality. This double-way, reciprocal form of causal determinism applies not only within the brain but throughout nature to emergent properties in general. It follows accordingly that traditional «scientific materialism» as

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lawful explanations at a given level into laws that apply to the lower-level components. In contradiction to continuing contentions that the causal paradigm of classical Newtonian physics allows no room for consciousness (e.g. 47, 70), the above described solution for inserting into brain function the causal influence of mental states is achieved within the general Newtonian framework.

THE TURNING POINT: RELEVANT CHRONOLOGY

To more precisely distinguish the interpretation supported here, it will help, firstly, to further extend the historical background beyond the level of scientific disciplines and mainstream doctrine to include that of individual personal precursor views that were present or appeared during the decade prior to the 1970s turnaround in mainstream psychology. Secondly, we need also to recognize that the closely involved debate over emergence, reductionism, and wholism has an extremely long history, traced by some philosophers back to Aristotle and Democrites. This debate is still going strong today. The issues therefore are by no means simple, or easily settled. For historical background, there is thus good reason to start, not from any particular individual argument, but from the prevailing majority view and its fluctuations during the preceding decades.

Following a prolonged period in which scientific reductionism and «logical positivism» had been in favor, the majority view in the 1920s underwent a strong swing toward recognition of emergence and holism, particularly in writings on emergent evolution (e.g. 39, 53, 58). By the 1940s and 1950s, however, emergent wholist theory again was gradually losing ground to reductionist views and by the early 1960s has sunk to an extreme low, overwhelmed by a strong pervasive upsurge of reductionism, occasioned in part by continued successes in physics but generated especially by dramatic new advances in molecular biology. Thus, by the early 1960s, reductionism again reigned - not only in physics (19), but also in biochemistry (45), molecular biology (11), psychology (56), information theory (55), philosophy (2, 14, 27, 28, 49, 57), and nearly everywhere - including even in Gestalt psychology, the early prime stronghold of configurational theory (31). General Systems Theory also at this time was accepting reductionist logic as a basic structural principle (4, 69).

This strong upswell of reductive physicalist thinking, described by philosopher Thomas Nagel (40) as a «wave of reductionist euphoria», was soon again, however, to give way to an opposing wave of holism, emergence and «irreducibility» (e.g. 5, 30, 34, 44, 46, 47). This latter wholist movement has continued since to burgeon into an extreme new high that still today is gaining further ground both within and outside science, extending even into cosmology (26) and a «postmodern» theology (23).

This latest mainstream swing from extreme reductionism to an all-time high in wholistic thinking, rather abrupt in terms of historical precedents, poses a key question: «What happened that served to break the 1960s wave of reductionism and turned it around into a general new high for wholism, a development so marked that today it prompts proposals for a new «science of wholeness»? (25). Specifically, what turned the «reductionist euphoria» of the 1960s into the current boom in holistic «new sciences»? Also in the same period, what prompted the rise of similar antireductionist thinking in «The New Philosophy of Science» (36)? The answers, I believe, are found in the same conceptual development that enabled the revolutionary turnabout in the scientific conception and treatment of consciousness.

The five year period starting from about the mid-1960s thus becomes, in this analysis, a crucial turning point in the history of both the reductionist debate and also that of the mind-body relation. It also will be seen that this same period represents a turning point as well, as a secondary effect, for the fact-value or science-values dichotomy (17), and also for the ancient paradox of freewill and determinism (12). Further, it is these collective changes that, in our present view, are inferred to have set the stage for the unprecedented outburst in the 1970s and 1980s of proclaimed new worldviews, new epistemologies, ontologies and new sciences of mind, of life, of qualities, and so on. In this «flow-of-history» analysis, the current swing from reductionism to wholism has much in common with the concomitant swing from behaviorism to mentalism. Both shifts are seen to be interlinked and inseparable. Both are dependent upon the bi-directional model of causality with its «top-down» emergent determinism. The same modified concept that placed mental states in a causal role, refuted also the adequacy of traditional «bottom-up» physicalism, and gave emergent macro-qualities in general (including the mental) a new irreducible causal status.

This analysis accounts as well for the broad array of new epistemic developments of the past two decades, all of which appear to share in common with the above the rejection of traditional materialism. Four major transformative developments visible in the recent literature are taken to be involved, all related, and all traceable to origins in the same critical 5-year period. These include (1) the diametric turnabout in the causal status of consciousness; (2) the shift from extreme reductionism to extreme holism; (3) a new recognition and wide acceptance of «top-down» emergent determinism; (4) a sudden, still-continuing upsurge in radical new outlooks and paradigms in science and philosophy. All four can be understood and accounted for in terms of the same basic concepts required for the turn-about in the causality of consciousness.

This bring us to another critical point in my argument, namely, its dependence upon an assumption that the 1970's changeover from behaviorism to cognitivism in mainstream

psychology and my own similar shift to mentalism were both effected on the basis of the same theoretic shift to the same new mentalist paradigm. Support for this is twofold: firstly, it hardly seems plausible that the powerful, seemingly incontestable physicalist paradigm of science with its rigorous exclusion of mentalistic explanation - along with its behaviorist counterpart in psychology - could suddenly, after having successfully fended off all challenges for centuries, have been toppled twice within a few years by *two different* mentalist theories. The ruling dictum of the materialist era that mind does not interact with matter, and its time-tested reasoning, supposed to be logically cohesive, complete, and irrefutable, is hardly something in which one would expect to suddenly find two separate errors. This alone appears to justify the assumption that in both instances the conceptual foundation behind the new mentalistic/cognitive thinking has to be, in essence, one and the same.

Secondly, this assumption gains added support from the historical record and chronologic correlations evident in the following brief outline of the early expressions of the new «mentalism».

1964. An initial brief statement of downward causation in application to evolution, molecular and organismal behavior, including nonreductive downward control of the mental over the neuronal in brain function (Sperry, 62, pp 2, 20). This posed a direct challenge to the then-prevailing reductionist outlook and came at a time well before the onset of any awareness of a coming paradigm shift (18, 40, 54, 56).

1965. First full presentations (47, 63). The new outlook was described by Karl Popper as «a solution to... the classical Cartesian body-mind problem» explaining «*interaction* of mental and physical states», and bringing «a different view of the world». I presented it as «*an alternative mentalist position*» that «restores the mind to the brain of objective science», and «a long sought unifying view» that «would eliminate the old dualistic confusions, dichotomies, and paradoxes», also as a scheme that gives «plenty of free will, provided we think of free will as self-determination», and finally as an «objective explanator y model of brain function that neither contradicts nor degrades but affirms age-old humanistic values». The mentalist/cognitive paradigm is still viewed today in very much these same terms.

1966. Wide exposure in a reprinting in *The Bulletin of the Atomic Scientists* (63) instigated by biochemist-futurist John Platt. This bulletin, with its famous «doomsday clock» and subtitle «*Journal of Science and Public Affairs*», gave very broad exposure in those years, not just among physicists.

1969. More specialized presentations: in *Proceedings of the National Academy of Sciences* (64) later published in full in *Psychological Review* (65), in philosopher Marjorie Grene's international «*Concepts of Mind*» *Workshop* (22) and in the 1969 *Proceedings of the Association for Research of Nervous and Mental Diseases, a Program on Perception and its Disorders* (66).

1970. Critique in *Psychological Review* by Dalbra Bindra (6), and my response to Bindra (67) also in *Psychological Review* (perhaps these two combined were most influential in tipping the scales). By the following year, publications in psychology were beginning to express growing awareness of a general paradigm shift (43).

A competing concept, the «computer program analogy» of mental function, also could be said to qualify in respect to chronology and is frequently cited as having had a strong influence in bringing about the consciousness revolution. Presented at length in a 1960 book by Miller, Galanter & Pribram (38), and more pointedly in a later text by Ulrich Neisser (42), the computer analogy was surely influential in opening the way to a new appreciation of cognitive factors in a control role in brain function. The computer-program relation, however, can equally well be viewed, like most other physical phenomena, in traditional analytic reductive physicalist terms, and generally was so taken prior to the introduction of downward causation in the mid-1960s. In itself, the computer-program analogy does not demand a shift to mentalism, nor to a causal or emergent view of conscious experience, and it clearly had not done so by 1963-64 when the ongoing debates in psychology between behaviorists and phenomenologists (e.g. 25, 54, 56, 72) continued in the same vein as before, essentially unaffected by any new cognitive or mentalist approach. Further, the impact of the volume by Miller et al. (38) plus the influence of related work of this period with computers, information theory and Artificial Intelligence, had failed collectively to alter the basic «in-principle» reductionist position and thinking of leaders in the field (55).

The factors responsible for psychology's sudden swing to mentalistic explanations (50) following a half century of rigorous renunciation, were not clear at the time and still today remain subject to ongoing controversy. Mainstream psychologists tend to overlook emergent interaction and the above cluster of related developments in favor of various others more directly affiliated with research programs and theory confined to psychology proper. As yet, however, there is no consensus. The various subfield groups still vie with one another in ascribing the origins to their own specialty (e.g. 1, 3, 7, 13, 21, 37, 43). According to the present analysis, the majority of these alternative views either fail to stand up in historical examination or they deal with subordinate theories of the behaviorist period not critical to *Behaviorism per se* as an overarching paradigm that makes psychology consistent with neuroscience and the other natural sciences (51, 56).

Behaviorist doctrine, for example, in its early stages was heavily invested in conditioned reflex learning (29). This included reliance on pre-natal conditioning to an extent that the very concept of instinct as posited in European ethology had become a term of derision (35). Behaviorism's denunciation of any inheritance of behavior traits was supported by abundant, seemingly unequivocal experimental evidence

that the growth and formation of nerve connections is entirely diffuse and nonselective (24, 73). The case against instincts, however, was totally turned around in the early 1940s by new experiments showing that intricate inherited nerve networks can indeed be grown into the brain directly, unaided by learning, and organized with great precision through an elaborate scheme of genetically-controlled chemical coding of individual cells (59, 61).

Soon after this, another serious flaw in behaviorist theory was pointed out by Karl Lashley (33) in his critique of chained stimulus-response associations as the basis for serial order in behavior. Lashley used language as a main example, and this was reinforced by linguist Noam Chomsky (10), with an added suggestion that the deep structure of language is not learned, but inherited. Such inheritance, previously unthinkable, had become theoretically plausible by the mid-1950s as a result of the growing evidence for high precision and complexity in the inherent chemoaffinity factors in fetal brain organization (61). Other theoretical thrusts of the behaviorist era, including the extreme peripheralism, the environmental, «black box» or «empty organism» emphasis, and Hull's Stimulus-Response scheme for a comprehensive theory covering all behavior also came into decline and helped contribute to a growing loss of confidence in so-called «behaviorist» answers.

For present purposes the main point to note here is that none of these types of theoretical setbacks, individually or collectively, served to overthrow Behaviorism *per se* as a conceptual framework, a philosophy of science, or overriding metatheory that rejects introspective mentalistic explanations and restricts behavioral science, like the other natural sciences, to what is objectively observable and measurable. Remaining «behaviorists» today defend their position with claims that the exclusion of mental constructs had been only a methodological principle. Actually at the time, and in harmony with brain research, physics, and the rest of science, it was much more than this. Behaviorist thinking, through the 1950s as in the rest of science, excluded any interactive influence of conscious subjective qualities on the course of physical brain function. Conscious states, that is, were held to be *epiphenomenal,* not *causes* of behavior (56; 72, p 135).

MIND MERGED WITH MATTER: IS IT MATERIALISM? DUALISM? MENTALISM? ....OR?

The new conception of mental states in a causal interactive role was classified by Popper (47), and by many others since, as a «dualistic» solution. This was in accord with past terminology in which «mentalism» had traditionally been equated with «dualism». In contrast, however, I have described this new form of mentalism from the start (67, 68) as a quite different intermediate position which is monistic, not dualistic. In my view, mental phenomena as dynamic emergent properties of physical brain states, become inextricably interfused with, and thus inseparable from their physiologic substrates. At the same time, they are taken to be distinguishable from the brain substrate in the way that an emergent property is distinguished from its infrastructure, even though it is critically dependent upon and determined by the component events. Though mental states, at present, are not observable or measurable, they are presumed, in principle, to be something accessible to eventual scientific description «like the interior of the earth» with further advances in technology. It thus becomes a moot question as to whether this modified concept of a mental state as a dynamic emergent retaining its subjective quality or «raw feel», should now be called a «material» or a «mental» process.

Either way, the overall outcome is a coherent hierarchic view of nature with increasingly complex physical systems having diverse emergent properties which include the mental emergents of the brain-mind system, all part of a monistic natural order. The traditional difference between the physical and the mental (as subjectively perceived) is deliberately retained, but with these previously separate, dual realms now inextricably merged. Questions and opinions are continually raised as to whether this type of mind-brain solution ought to be called *materialistic* or *mentalistic*. It is only natural that persons with previous investments in one or the other, should want to call it a modified form of their former position. Confirmed dualists Popper and Eccles (48), for example, espoused it as dualistic «psychophysical interaction», whereas I preferred to call it a nondualistic «new», «neo-» or «alternative» mentalism (63). The latter better serves to distinguish the new features. It emphasizes the reductive physicalist errors of the past, and also the revolutionary, radically revised world-outlook and story the new solution brings to science. I have outlined elsewhere other reasons (e.g. 67, 68, 69) why «mentalism» seems to me, overall, to be preferable to «materialism», at least from the standpoint of behavioral science.

About ten years after Popper and I had separately described this new solution to the mind-brain problem (47, 63) and some four years after its adoption by mainstream psychology in its new mentalist paradigm (13, 37, 43), the same solution was rediscovered by philosopher Mario Bunge (8, 9), but renamed as a new «emergentist materialism» - with myself conveniently misclassified as a dualist, and psychology's shift to cognitivism not mentioned. This ongoing controversy over terminology has caused puzzlement and confusion from the start (6, 67). Psychologist Thomas Natsoulas (41), specializing in the history of consciousness, correctly points out that the new answer blends together features from previously opposed solutions, and then, in reaction to its misclassification as

«dualism», calls it a type of «physical monism». Why the more recent «property dualism» (e.g. 32) is not a rational solution has long been apparent (66).

Certainly Bunge's «materialism» and Natsoulas' «physicalism» find more ready acceptance in modern science and philosophy than does «mentalism». In retrospect, it might accordingly have been wiser had we used some emergent materialist/physicalist label from the beginning. However, it still seems to be a mistake overall to abandon the age-old commonsense distinction between mind and matter, the mental and the physical. This basic common distinction long preceded the varied philosophic and scientific terminology. The highly distinctive specialness of conscious states with their subjective qualities does not go away just because they are taken to be emergent properties of physical brain processes.

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